PORTABLE INFORMATION RADIO TERMINAL DEVICE AND MANUFACTURING METHOD THEREOF

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates generally to a portable information radio terminal device or a personal digital assistance (PDA) and a manufacturing method thereof. More particularly, the invention relates to a portable information radio terminal device and a manufacturing method thereof, which can effectively prevent peeling off, breakage or so forth of electrical connecting portion of an electronic parts mounted on a printed circuit board in a device casing.

Description of the Related Art

Conventionally, as shown in Figs. 3A and 3B, a printed board 12 incorporated in a portable information radio terminal device 11 is secured in a device casing by screws 15 and bosses 17. Accordingly, when an impact is exerted on the portable information radio terminal device 11, portions secured by the screws cannot follow with vibration or deflection of the printed circuit board 12 caused by exertion of the impact to cause stress concentration about the portions secured by the screws to amplify vibration or deflection of the printed board 12. As a result, peeling can be caused in solder ball (electrical connecting portion) of a chip size package (CSP) mounted on

the printed board 12.

In Japanese Unexamined Utility Model Publication No. Showa 58-162689, the following technology has been disclosed. Disclosed in the above-identified publication is a printed board support structure of an electronic equipment, in which a printed board mounting a printed wiring and various parts, such as relays and so forth, is rigidly fixed in a casing. Elastic engaging projections are projected from a printed board mounting surface of the casing. Also, an auxiliary projections are projected in opposition to the elastic engaging projections across the printed board with a distance. In the printed board, engaging holes to engage with the engaging projections are formed for forming the supporting structure of the printed board of the electronic equipment. On the other hand, between each of supporting portions of the casing and the printed board, elastic member, such as rubber member is disposed within a space portion for accommodating tolerance.

On the other hand, in Japanese Unexamined Patent Publication No. Heisei 8-23181, the following technology has been disclosed. A circuit board has a structure to be tightly clamped by first and second rollers. When the circuit board is inserted between the first and second rollers, the first and second rollers are rotated in a board inserting direction by a frictional force. With such construction, vibration to be caused in the equipment casing is absorbed to protect the

circuit board from vibration. Furthermore, the circuit board can be smoothly inserted into the casing.

It is desirable to maintain electrical connection of the electronic pats mounted on the board in the device body when the portable information ratio terminal device is subject to an impact (external force) due to falling down or so forth. It is also desired that large vibration and/or impact will not be transmitted to the electronic parts within the device body to maintain electrical connection of the electronic parts and thus not to be a cause of failure of the electronic parts.

Also, it is desired to easily produce the portable information radio terminal device resistant against the impact set forth above.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a portable information radio terminal device or personal digital assistance (PDA) which can maintain electrical connection of electronic pats mounted on the board in a device body when the portable information ratio terminal device is subject to an impact (external force) due to falling down or so forth.

Another object of the present invention to provide a portable information radio terminal device, in which large vibration and/or impact will not be transmitted to the electronic parts within the device body to maintain electrical

connection of the electronic parts and thus not to be a cause of failure of the electronic parts.

A further object of the present invention is to provide a manufacturing method to easily manufacture the portable information radio terminal device resistant against the impact set forth above.

According to the first aspect of the present invention, a portable information radio terminal device comprises:

a device body;

an electronic part provided in the device body; and

an elastic member supporting the electronic part within the device body.

According to the second aspect of the present invention, a portable information radio terminal device comprises:

a device body;

a printed board provided in the device body;

an electronic part provided on the printed board; and

an elastic member supporting the printed board within the device body.

In the preferred construction, the device body may include a first and second casing to be assembled with each other, and the elastic member may be disposed between the printed board and the first casing and between the printed board and the second casing.

A direction of an elastic force acting on the printed

board from the elastic member disposed between the printed board and the first casing and a direction of an elastic force acting on the printed board from the elastic member disposed between the printed board and the second casing substantially may match with a direction of assembling the first and second casings.

The elastic body may be pressurized by assembling the first casing and the second casing. It is also possible that the elastic member is provided at only one side of the printed board in the longitudinal direction, and the other end side of the printed board in the longitudinal direction is situated as a free end.

The device body may be divided in longitudinal direction into first and second halves, and the elastic member may be provided only on one of the first and second halves where a gravity center of the portable information radio terminal device is located.

A plurality of elastic members may be provided per one side of the printed board.

According to the third aspect of the present invention, a manufacturing method of a portable information radio terminal device for assembling a first casing and a second casing, and housing a printing board between the fir and second casing, comprises:

a step of arranging the printed board on one of the first and second casings via an elastic member; and

a step of assembling the other of the first and second casings to the one of the first and second casing with interpositioning the elastic member between the other of the first and second casings and the printed board.

Preferably, the first and second casings may be assembled with pressurizing the elastic member.

The portable information radio terminal device according to the present invention can reduce concentration of stress to be caused in response to an impact upon falling down or so forth by holding the printed board assembled in the device body by the elastic member, such as impact absorbing material having high elastic force.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description given hereinafter with reference to the accompanying drawings of the preferred embodiment of the present invention, which, however, should not be taken to be limitative to the present invention, but are for explanation and understanding only.

Figs. 1A and 1B show the first embodiment of a portable information radio terminal device according to the present invention, in which Fig. 1A is a front elevation, and Fig. 1B is a section taken along line A - A of Fig. 1A;

Fig. 2 is a front elevation of a printed board and an elastic body of the second embodiment of a portable information

radio terminal device according to the present invention; and

Figs. 3A and 3B show the conventional portable information radio terminal device according to the present invention, in which Fig. 3A is a front elevation, and Fig. 3B is a section taken along line B - B of Fig. 3A.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will be discussed hereinafter in detail in terms of the preferred embodiment of the present invention with reference to the accompanying drawings. In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be obvious, however, to those skilled in the art that the present invention may be practiced without these specific details. In other instance, well-known structure are not shown in detail in order to avoid unnecessary obscurity of the present invention.

Figs. 1A and 1B show the first embodiment of a portable information radio terminal device according to the present invention, in which Fig. 1A is a front elevation, and Fig. 1B is a section taken along line A - A of Fig. 1A. As shown in Figs. 1A and 1B, a portable information ratio terminal device 1 has a receiver portion 1a, a transmitter portion 1b, a liquid crystal display portion 1c and an operation portion 1d. A print board 2 assembled with a device body 1H is held through an elastic member 5.

As shown in Fig. 1B, the elastic member 5 is tightly fitted between an upper casing 3 and the printed board 2 and between a lower casing 4 and the printed board 2 without any gap under slightly pressurized condition. If gap is present, impact absorbing ability and stress distribution performance can be lowered.

When the portable information radio terminal device 1 is subject to an impact due to falling down or in other reason, a phenomenon to cause large vibration and deflection on the upper casing 3, the lower casing 4 and the printed board 2 assembled in the device body 1H occurs. At this time, vibration and deflection between the upper casing 3 and the printed board 2 and between the lower casing 4 and the printed board 2 is absorbed by the elastic member 5. Also, since bonding points of the elastic member 5 to the printed board is not single, and the elastic member 5 does not act for fix the printed board against vibration or deflection, stress concentration can be avoided. Accordingly, occurrence of large vibration on the printer board per se can be reduced. By this, CPSs mounted on the printed board may not peel off the printed board 2.

As shown in Fig. 1B, the printed board 2 has a length in a longitudinal direction about half of that of the device body 1H to be arranged at approximately upper half in the longitudinal direction of the device body 1H. On a surface of the printed board 2 opposing to an inner surface of the lower

casing 4, electronic parts, such as CSPs (Chip Size Packages) are mounted.

Among components in the portable information radio terminal device 1, a weight of the liquid crystal display portion 1c becomes relatively large which can be a large proportion in a overall weight of the portable information radio terminal device 1. As shown in Fig. 1A, since the liquid crystal display portion 1c is located at upper side of half in the longitudinal direction of the device body 1H, a gravity center of the portable information radio terminal device 1 is located at upper side of the center portion in the longitudinal direction. Accordingly, when the portable information radio terminal device 1 falls down, it inherently fall in the upside-down attitude collide at the upper side to easily subject to impact. For this reason, in order to obtain efficient impact resistance, a portion holding the printed board 2 on the device body 1H with the elastic member 5 is set at upper side in the longitudinal direction of the portable information radio terminal device 1 and in the vicinity of the uppermost position of the printed board 2.

The printed board 2 is supported only on the side close to the uppermost position thereof to situate the other end of the printed board 2 in the longitudinal direction as free end. This works together with elasticity of the supporting portion (elastic member 5) of the printed board 5 to cause appropriate

degree of elastic deformation in the printed board 2 without causing local stress concentration when external force is applied to the portable information radio terminal device 1, to cancel energy of the external force acting on the printed board 2. Accordingly, stress concentration will not be caused in electrical connecting portion of the CSP 6 on the printed board 2 or the CSP per se.

A contact area of the elastic member 5 with the printed board 2 and a contact area of the elastic member 5 with the upper casing 3 or the lower casing 4 are substantially the same as each other. The contact area is desired to be as large as possible. By providing large area for supporting the printed board 2 by the elastic member 5, stress is not concentrated when the portable information radio terminal device 1 is subject to impact to prevent the printed board from vibrating or deflecting.

As set forth above, the elastic member 5 supporting the printed board 2 abuts with the upper casing 3 and the lower casing 4 of the device body 1H. When the portable information radio terminal device 1 is fallen down, it tends to fall down to abut onto the ground from the upper surface of the upper casing 3 to be an operation surface and a display surface or from a back surface of the lower casing 4 located on the back side to easily cause impact. Associating with this, the elastic body 5 abut on the surfaces extending in surface

direction of the upper surface and the back surface of the device body 1H in order to enhance impact absorbing ability.

Bonding of the elastic member 5 onto the printed board 2 and the upper and lower casings 3 and 4 is done by various adhesive. In this case, corresponding to a bonding force applied by the adhesive per se, clamping force to depress the elastic member 5 onto the printed board 2 from the upper and lower casings 3 and 4 may act.

Material and elastic modules of the elastic member 5 are selected for effectively absorbing impact to be exerted onto the portable information radio terminal device 1 upon fallen down from a height supposed in normal use condition, and to effectively prevent failure of the electronic parts and/or peeling off of the connecting portion.

In the embodiment shown in Fig. 1(b), the elastic member 5 is arranged both between the printed board 2 and the upper casing 3 and between the printed board 2 and the lower casing 4. In the shown embodiment, the elastic member 5 is consisted of mutually separate elastic components respectively disposed between the printed board 2 and the upper casing 3 and between the printed board 2 and the lower casing 4. However, instead of forming the elastic member 5 with separated two elastic components, it is possible to form it with a single elastic component with a cut out portion for receiving the printed board 2 therein.

Upon supporting the printed board 2 by an elastic force of the elastic member 5, a direction to apply the elastic force onto the printed board 2 matches with a direction to mating and assembling the upper casing 3 and the lower casing 4 upon manufacturing of the portable information radio terminal device 1 (horizontal direction in Fig. 1B). Accordingly, upon manufacturing of the portable information radio terminal device 1, in the condition where the printed board 2 is placed at a predetermined position on the inner surface of one of the upper casing 3 and the lower casing 4 via the elastic member 5, the other of the upper casing 3 and the lower casing 4 is fitted via the elastic member 5 arranged on the inner surface. By this, the elastic member 5 is properly pressurized with each other with respect to the upper casing 3, the lower casing 4 and the printed board 2. In this case, between the upper casing 3 and the lower casing 4 preliminarily molded into predetermined shapes, respectively, the elastic member 5 is disposed to adjust the elastic force of the elastic member 5 acting on the printed board 2 automatically and optimally. This can be achieved either in the case where the elastic member 5 is formed with separated two elastic components or in the case where the elastic member 5 is formed with one elastic member with the cut out portion.

On the other hand, while not illustrated in the drawings, the elastic member 5 can be provided only on one side between